LINEUP WITH MATH™

Math-Based Decisions in Air Traffic Control
for Grades 5 - 9

Problem Set D

Understanding the Effects of Differences in Speed

Teacher Guide with Answer Sheets

Overview of Problem Set D

Estimated class time: 1 to 2 hours

In this Problem Set, students will be introduced to the effects of speed changes on airplane spacing.

In the previous *LineUp With Math*™ Problem Sets, students used route changes to resolve spacing conflicts. In this Problem Set, students begin to explore the effects of speed differences on airplane spacing. This will prepare them for subsequent Problem Sets where they resolve spacing conflicts via speed changes.

Objectives

Students will:

- Learn that when a plane's speed is reduced, the difference in the plane's distance traveled can be calculated by multiplying the difference in speed by the time traveled. (For a mathematical derivation of this relationship, see Appendix II.)
- Learn how to relate a decrease in plane speed in knots to a decrease in distance traveled each minute.
- Learn the correspondence between a 60-knot reduction in plane speed and the resulting decrease in distance traveled (in 1 minute) over a 10 Nmi interval on a jet route. (Students will encounter these particular speed reductions and multiples of 10 Nmiles in subsequent workbooks.)

Prerequisites

Before attempting the current Problem Set, it is *strongly* recommended that students complete Problem Set A that provides essential air traffic control vocabulary, units, and representations.

Materials

- Student Workbook D (print-based)

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The materials are available on the *LineUp With Math*™ website:

http://www.smartskies.nasa.gov/lineup

Student Workbook

It is recommended that you have a copy of Workbook D open while you read these notes.

The Workbook consists of four worksheets.

For a complete set of answers to each worksheet, see Appendix I of this document.

For each worksheet, the key points are briefly described as follows.

Worksheet: *Introduction to Travel at Different Speeds*

- Students will use two number lines to plot the positions (in one-minute intervals) of two students walking at different rates. Since the difference in rates is 1 step per minute, the slower student will fall behind 1 step each minute. So over a period of 5 minutes, for example, the slower student will fall behind 5 steps.
- When the difference in rates is 2 steps per minute, the slower student will fall behind 2 steps each minute. So over a period of 5 minutes, for example, the slower student will fall behind 10 steps.

Worksheet: *Change Knots to Nautical Miles per Minute*

- In the previous Workbooks, students worked with plane speeds in knots (nautical miles per hour). However, controllers need to make decisions in minutes. So students learn how to change knots to nautical miles per minute.
- In particular, students practice relating a 60-knot (nautical miles per hour) speed decrease to its equivalent 1 nautical mile per minute speed decrease.

Worksheet: *Plot Distances for Different Plane Speeds*

- This worksheet revisits the same speed relationships introduced in the previous worksheet that featured two planes flying at different speeds. The plane speeds differed by 60 knots. That corresponds to a speed difference of 1 nautical mile per minute. In the current worksheet, rather than plot plane positions on number lines, the students plot plane positions on the sector diagram.
- The students generalize the relationship between speed difference and distance traveled in the same time to examine a speed difference of 2 nautical miles per minute. They apply proportional reasoning to answer several questions.

Answer Sheets

Answer sheets for each worksheet in Student Workbook D can be found in Appendix I of this document.

For a mathematical derivation of the relationship between the difference in plane speed and the difference in distance traveled, see Appendix II of this document.